Claims

What is claimed is:

1. An integrated circuit package, comprising

a die;

a heat sink; and

a thermal intermediate structure comprising a plurality of carbon nanotubes, some of which are tethered to at least one of the die and the heat sink.

2. The package of claim 1, wherein the surface of the at least one of the die and the heat sink has a metal coating.

3. The package of claim 2, wherein the metal coating is gold.

4. The package of claim 3, wherein at least one end of the some of the carbon nanotubes have organic moieties attached.

5. The package of claim 4, wherein the organic moieties include an amide linker chemically bonded to the end of the some carbon nanotubes of the plurality of carbon nanotubes.

6. The package of claim 4, wherein the organic moieties include an amide linker chemically bonded to the end of some of the plurality of carbon nanotubes and a thiol based linker to link to the surface of at least one of the die and the heat sink.

7. An integrated circuit package, comprising

a die;

a heat sink; and

a first thermal intermediate portion comprising a plurality of carbon nanotubes, some nanotubes of which have organic moieties attached to one end thereof, the one end of some nanotubes chemically bonded to the heat sink; and

a second thermal intermediate portion comprising a plurality of carbon nanotubes, some nanotubes of which have organic moieties attached to one end thereof, the one end of some nanotubes chemically bonded to the die.

8. The package of claim 7, wherein the organic moieties of the first thermal intermediate portion and the organic moieties of the second thermal intermediate layer include amide linkers.

9. The package of claim 7, wherein the organic moieties of the first intermediate potion and the organic moieties of the second intermediate layer include thiol linkers.

10 The package of claim 7, wherein the organic moieties of the first intermediate portion and the organic moieties of the second intermediate portion include thiol linkers and amide linkers.

11. The package of claim 10, wherein the carbon nanotubes of the thermal intermediate portions are generally perpendicular to a surface of the die or the surface of the heat sink.

12. A thermal interface structure, comprising

a plurality of carbon nanotubes, some of which have organic moieties attached to one end thereof to tether the interface structure to a surface of at least one of a heat sink and an electronic circuit die.

13. The thermal interface structure of claim 12, wherein the surface comprises a gold coating.

14. The thermal interface structure of claim 13, wherein the organic moieties comprise thiol linkers.

15. The thermal interface structure of claim 13, wherein the organic moieties comprise amide linkers.

16. The thermal interface structure of claim 13, wherein the organic moieties comprise thiol and amide linkers.

17. A computing system, comprising:

at least one dynamic random access memory device;

a die having a circuit thereon to couple to the memory device;

a heat sink; and

a thermal intermediate structure comprising a plurality of carbon nanotubes, some of which are tethered to at least one of the die and the heat sink.

18. The system of claim 17, wherein the circuit comprises a processor that acts upon data signals, and may include, for example, a microprocessor.

19. The system of claim 17, wherein the organic moieties comprise amide linkers.

20. The system of claim 17 wherein the organic moieties comprise thiol linkers.

21. The system of claim 17, wherein the organic moieties comprise amide linkers and thiol linkers.

22. A process:

coating at least one surface of least one of a heat sink and of a die with a metal;

treating at least one end of at least some of a plurality of carbon nanotubes by applying organic moieties thereto; and

tethering one end of the at least some of the carbon nanotubes of the plurality of carbon nanotubes to the metal.

23. The process of claim 22 wherein the metal is selected from the group consisting of gold and gold alloys.

24. The process of claim 23, wherein the treating the at least one end of some of the plurality of nanotubes comprises forming an amide based linkage thereon.

25. The process of claim 23, wherein the treating the at least one end of some of the plurality of nanotubes comprises forming an amide based linkage and a thiol based linkage thereon.

26. A method, comprising:

oxidizing at least one nanotube rope in acid to cut it into short nanotubes with open ends having carboxyl linkages attached thereto;

forming organic moieties at the open ends;

tethering an end of the short nanotubes to a surface of a first object; and

placing a surface of a second object in contact with another end of the short nanotubes to form a thermal path between the surface of the first object and the surface of the second object.

27. The method of claim 26 wherein the first object is an electronic circuit die and the second object is a heat sink.

28. The method of claim 26 wherein the first object is a heat sink and the second object is an electronic circuit die.

29. The method of claim 26 wherein the organic moieties comprise an amide linker.

30. The method of claim 29 wherein the organic moieties also comprise a thiol linker.